An Apparently Seasonal Occurrence of Halotrichite in Vinton County, Ohio

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ABSTRACT

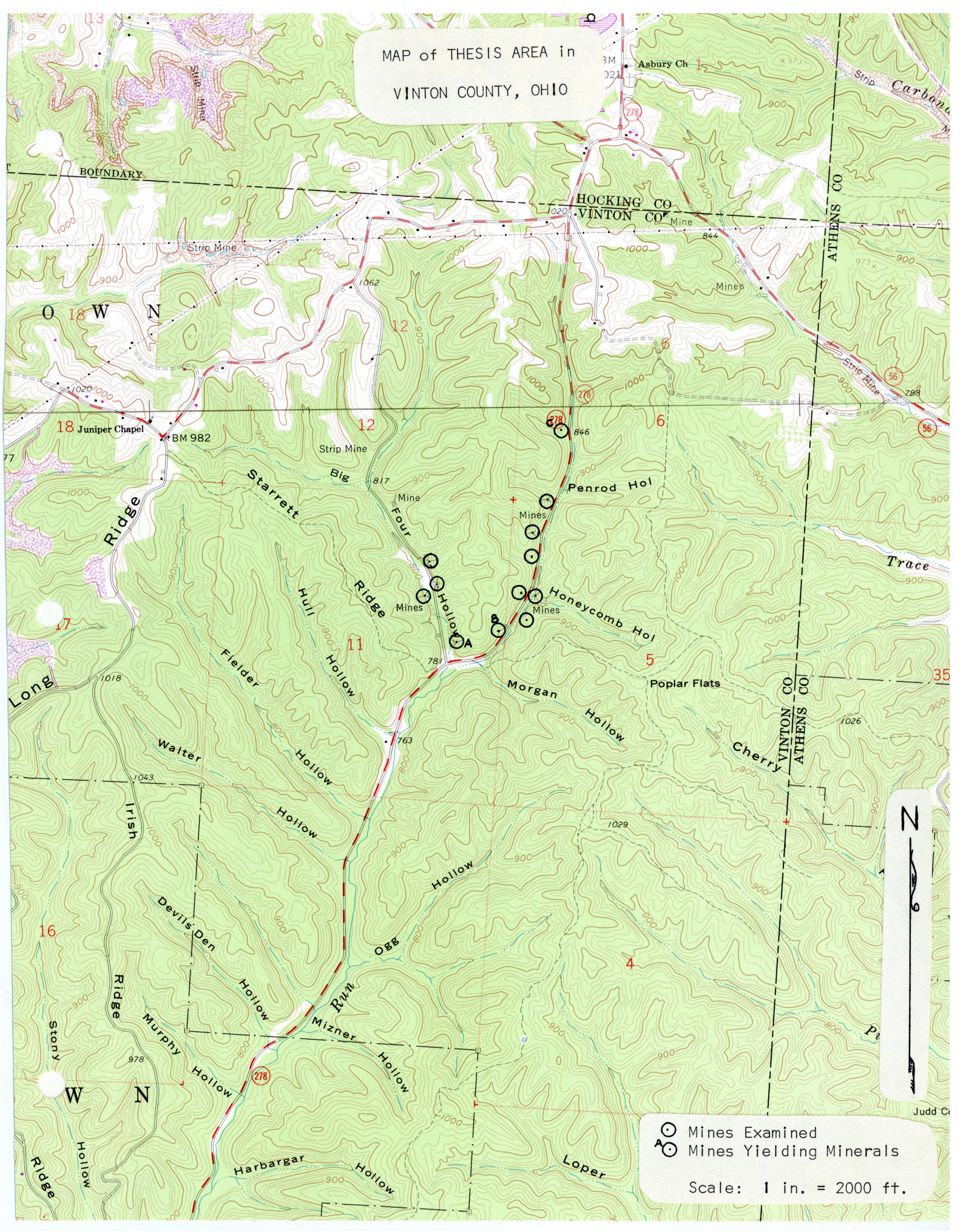
Several abandoned coal mines in Vinton County, Ohio were examined over a period of four months, for efflorescent minerals. Mineral deposits were found to be actively forming and in one instance new deposits of halotrichite were found, on the third visit, in a mine that had previously shown no evidence of efflorescent mineral deposits.

OBJECTIVE

The literature concerning minerals found in southeast Ohio coal mines reveals that melanterite ($FeSO_4 \cdot 7H_2O$)(Ehlers & Stiles, 1965) and halotrichite ($FeAl_2(SO_4)_4 \cdot 22H_2O$)(Brant & Foster,1959) are known to occur in some mines of this area. Both of these efflorescent minerals, that is minerals that have formed as excess water evaporates into the atmosphere, had been found in mines located along the upper reaches of the Sandy Run tributary to Lake Hope in Vinton County (see map). Mines were investigated in Vinton County to determine the extent to which these two minerals occurred, and in addition to determine if there were similar efflorescent deposits that had not been described.

STUDY AREA

This study concerns itself with coal mines found in the northeast quarter of section 11, the northwest quarter of section 5 and the southwest quarter of section 6 in Brown Township of Vinton County, Ohio. All of these mines have been abandoned for some time, apparently since before 1956


MAP of THESIS AREA in
VINTON COUNTY, OHIO
BOUNDARY
HOCKING CO
VINTON CO
ATHENS CO
Asbury Ch
Strip Mine
Mine
Mines
Juniper Chapel
BM 982
Starrett Ridge
Big Four Ridge
Penrod Hol
Honeycomb Hol
Trace
Hull Hollow
Fielder Hollow
Morgan Hollow
Poplar Flats
Cherry
Long
Walter Hollow
Irish Ridge
Devils Den Hollow
Ogg Run
Mizner Hollow
Murphy Hollow
Stony Ridge
Harbargar Hollow
Loper
Judd Cr
Mines Examined
Mines Yielding Minerals
Scale: 1 in. = 2000 ft.

(Brant & Foster, 1959). The mines were examined in January, March and April of 1982.

On the first visit to the area twelve mines were examined; however, of these only three proved to be possible study sites. The remaining mines could not be entered due to the collapse of the entrance to them or submergence in water.

GEOLOGY

The study area is underlain by rocks of the Allegheny and lower Conemaugh series of the Pennsylvanian system. These rocks contain several coal and clay beds of commercial thickness. In the mines examined in this area, coal had been mined from the Middle Kittanning Coal Bed (No.6) which is overlain by the Lower Freeport sandstone, which in this area tends to be massive (Brant & Foster, 1959).

The mines have been cut into valley walls throughout the area and extraction of the coal and sandstone has created protective overhangs at most entrances. It was at the entrance of the mines, under the overhang, or within the first few meters of the mine tunnel, that efflorescent minerals had been formed.

Mine A (see map) yielded no minerals during the first two visits; however, on the third visit extensive deposits of white to yellowish-white masses of fibrous efflorescent minerals were found on loose mine debris at the entrance, and extending some seven meters inside the tunnel.

Mine B had the most abundant deposits of minerals due to a large, naturally occurring overhang in the Lower Freeport sandstone. This is where Brant and Foster (1959) found magnesium halotrichite in the fall of 1956 and spring of 1957. Occurrences of deposits found at this site remained

relatively constant throughout the four month period they were observed. Only slight changes in the color and habit of these minerals were noted, with composition remaining the same. Two distinct mineral types were found here. One of varying colors of gray, brown and yellow on the ceiling and sides of the overhang, the other an obviously wetter, white fibrous mass on loose debris at the entrance of the overhang.

Only one mineral was found in mine C that appeared to be secondary to local rock type. This was a solution type of deposit precipitated from the sandstone on the side of the mine tunnel entrance.

IDENTIFICATION

All specimens collected were examined microscopically; however, only the specimens from the overhang of mine B and from mine C could be identified using optical methods due to the fine-grained fibrous nature of the other minerals. These proved to be gypsum and calcite respectively. McGue (1982), in a thesis done at about the same time as this one, studied the gypsum deposits of mine B in some detail. The other mineral from mine B and those from mine A proved to be too fine-grained and fibrous to be identified optically. Other investigators have had this same problem with efflorescent minerals (Foster & Hoover, 1963, and Brant & Foster, 1959). To identify these minerals, X-ray diffraction methods were used.

The minerals were prepared by grinding them to a fine powder with an agate pestle and mortar. A top-loaded powder mount of each was then run in a Norelco high angle X-ray diffractometer. CuK_{α} radiation was used with a nickel filter at 35KV and 15MA and 2° 2θ/minute. Results are shown in Table 1.

TABLE I: Comparison of X-ray Diffraction Data

Halotrichite*		mine A		mine B	
d-spacing	I/I	d-spacing	I/I	d-spacing	I/I
15.90	30	-	-	-	-
10.50	15	10.42	L	-	-
9.69	20	9.61	L	9.51	L
7.92	15	7.84	L	7.87	L
6.36	15	-	-	-	-
6.10	20	6.07	L	6.03	L
5.81	10	5.83	L	5.83	L
5.50	5	-	-	-	-
5.25	10	5.31	L	5.27	L
4.97	50	4.97	M	4.95	M
4.81	100	4.81	H	4.80	H
4.63	30	4.58	L	4.60	M
4.30	100	4.31	H	4.30	M
4.15	50	4.17	M	4.15	M
4.10	50	4.11	M	4.11	M
3.98	20	3.97	L	3.95	L
3.78	30	3.78	M	3.77	M
3.66	15	-	-	3.61	L
3.50	100	3.50	H	3.50	H
3.40	25	3.33	L	3.44	L
3.27	25			3.27	L
3.18	20	3.17	L	3.15	L
3.06	10	3.05	L	3.04	L
3.04	20			3.01	L
2.97	20	2.97	L	2.96	L
2.88	30	-	-	2.89	L
2.83	15	-	-	2.83	L
2.77	15	-	-	2.77	L
2.71	15	-	-	2.72	L
2.68	25	2.68	L	2.68	M
2.61	25	2.61	L	2.60	L
2.56	30	2.56	L	2.55	L
2.51	10	-	-	-	-
2.46	15	2.46	L	2.46	L
2.44	15	2.45	L	-	-
2.39	15	-	-	2.40	L
2.29	20	-	-	2.28	L
2.23	10	2.23	L	2.23	L

* ASTM Card #26-1425

L= Low, M= Medium, H= High

Halotrichite is the iron end-member of the halotrichite - pickeringite ($MgAl_2(SO_4)_4 \cdot 22H_2O$) series. It is often difficult to distinguish it from pickeringite by X-ray diffraction pattern alone (Brant & Foster, 1959). To insure that the specimens collected in mines A and B were truly halotrichite they were examined with a Vreeland Spectrometer to determine the magnesium content. No magnesium was present.

MINERALOGY

Halotrichite commonly forms as the weathering product of pyritic and aluminous sedimentary rocks and accumulates as an efflorescent in sheltered places. It is often observed as a recent deposit in mine workings from coal seams and is commonly associated with melanterite and gypsum, among other minerals (Palanche, Berman & Frondel, 1957).

Apparently the halotrichite in Vinton County forms as pyrite oxidizes to yield sulfate ions, which may react with iron and aluminum to form the salt halotrichite. The elements necessary to form this compound are found in mine waters. If conditions are proper the compound may reappear in protected sites further from the interior of the mine (Brant & Foster, 1959).

CONCLUSIONS

The abundant deposit of halotrichite found in mine A on only the third visit might be explained considering all factors necessary to form an efflorescent of this nature. The major factor believed to be involved is temperature. On the first visit to the area, temperatures were near $-12^{\circ}C$; at the third visit temperatures were closer to $15^{\circ}C$. This increase in temperature may be enough to allow an efflorescent to be

precipitated from the mine waters that are constantly carrying the necessary elements required to form halotrichite. If this is the case then halotrichite would be expected to appear on a seasonal basis as temperatures become warm enough for its precipitation. Cody and Briggs (1973) came to this same conclusion after studying halotrichite found in a state park in Iowa.

With this in mind, it is not surprising that no melanterite was found where it is known to have occurred only twenty years ago. Ehlers and Stiles (1965) found it to be very susceptible to changes in temperature and/or humidity. Perhaps conditions are still not adequate to allow melanterite to form and as seasonal conditions improve, enough water will evaporate to allow for its formation again.

It would be interesting to observe the mineral deposits in this area over a period of time, at least a year or preferably longer. Temperature and humidity readings could be taken during each visit. This would help substantiate the seasonal occurrence hypothesis and hopefully give some parameters to the conditions necessary to form these efflorescents. Water characteristics such as chemical content and flow rates should be studied as well.

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